

Financial Analysts' Coverage and Cost of Equity Capital - Evidence from US Firms -

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1. Introduction

Economic theories suggest that increasing information exposure about firms should lower its cost of equity capital. These theoretical relationships are developed with the notions that information reduces a firm's expected cost of equity capital by reducing investors' estimation risks (Barry and Brown 1985, 1986; Coles and Loewenstein 1988; Klein and Bawa 1976; Lambert, Leuz, and Verrecchia 2007); reducing adverse selection component of information asymmetry and increasing liquidity of firm's shares (Amihud and Mendelson 1986, 1988; Diamond and Verrecchia 1991; Glosten and Milgrom 1985; Leuz and Wysocki 2006; Verrecchia 2001); enlarging investor bases and improving risk sharing (Merton 1987); and reducing information risks (Easley and O'Hara 2004).

In general, empirical studies on the link between information environment and cost of equity capital can be carried out by two approaches.

On the one hand, direct link approach research attempts to link information (e.g., the number of financial analysts) to the cost of equity capital estimates. It empirically investigates the link between the cost of equity capital estimate, which is dependent variable, and proxy for information environment, which is independent variable. Although this approach enables researchers to document an empirical link between information and cost of equity capital, it does not explicitly answer one important aspect, which is also of interest. That is, even though

we can say, for example, more information about firms reduces its cost of equity capital; we don't know whether this documented result is driven by which mediating factors. This is due to the fact that there exist various theoretical models establishing a link between information and cost of equity capital based on various factors.

On the other hand, indirect link approach research, which investigates an association between information environment (e.g., the number of financial analysts) and proxies of variables expected to be theoretically related with cost of equity capital (e.g., bid-ask spread), often draw implications on a firm's expected cost of equity capital. Yet, none has explicitly conducted a study on a later link, between those variables and expected cost of equity capital.

This paper investigates the relationship between financial analysts and cost of equity capital using full indirect approach. Particularly, we examine the relationship between financial analysts and firm's expected cost of equity capital, using adverse-selection/market liquidity based theoretical model. Under this model, a link between information and cost of equity capital is motivated by the notion that investors with better information can take advantage of other investors who have less information, commonly referred to as adverse selection component of information asymmetry. These models argue that adverse selection component of information asymmetry introduces high transaction costs and/or illiquidity of firm shares, and further suggest that firms with those characteristics have high cost of equity capital. In other words, high transaction cost and illiquidity of firm shares reduce total returns that investors will receive. Investors therefore will demand high returns when investing in firm shares with those characteristics, which in turn imply a high cost of equity capital to firms.

Since financial analysts act as information intermediaries, who play an important role in disseminating information, it is argued that many financial analysts following a firm represent the high firm's information exposures for investors. It therefore has a relationship with a firm's cost of equity capital. For instance, Easley and O'Hara (2004, p.1578) state in an implication of their theoretical model that "attracting an active analyst following for a company can also reduce a company's cost of capital, at least to the extent that analysts provide credible information about the company."

2. Literature Reviews

Financial analysts act as information intermediaries, who play an important role in disseminating firm's information. They collect information about firms they follow from public

and private sources, evaluate its current performance, make forecasts about its future prospects, and recommend that investors buy, hold or sell its shares.

Overall, there are evidences that financial analysts add value in the capital market (Healy and Palepu 2001). Financial analysts' earnings forecasts and recommendations, for example, affect share prices (Francis and Soffer 1997; Lys and Sohn 1990). In addition, financial analysts are more superiors to time-series models in forecasting earnings. Their forecasts of earnings consequently are relatively more accurate because they are, presumably in part, able to incorporate more timely economy and firms news into their forecasts than are time-series models (Brown et al. 1987). Market participants consequently rely on financial analyst forecasts as a surrogate for the market's unobservable earnings expectations (Kothari 2001).

Chung et al. (1995) study the relationship between the numbers of financial analysts following a firm and bid-ask spread. Unexpectedly, this paper finds that average bid-ask spreads increase in the numbers of financial analyst followings. The authors attribute this positive relationship to analysts choosing to follow firms with high information asymmetries. Investors for those firms therefore interpret more analysts following a firm as a signal of higher information asymmetry and set correspondingly higher spread. Brennan and Subrahmanyam (1996), however, document opposite result. They show that increase in the number of financial analysts following a firm is associated with a decrease in spreads. Yohn (1998) examines analysts following and spreads, but only in the days before and after an earnings announcement, and finds that the average daily spreads around the earnings announcement are decreasing in the number of financial analysts following a firm. Roulstone (2003) states that, from a public information perspective, the number of financial analysts proxy for the amount of information available regarding a firm's value. Roulstone finds that analysts following have a negative and significant association with spreads.

3. Research Methodology

3.1 Hypothesis Statements

In this study, first, we employ relative bid-ask spread as a proxy for adverse selection component of information asymmetry. Bid-ask spread is commonly thought to measure adverse selection explicitly (Leuz and Verrecchia 2000). The reason is that bid-ask spread addresses adverse selection problem originated from transacting in firms shares in the presence of asymmetrically informed investors. Less information asymmetry implies less

adverse selection which, in turn, implies smaller bid-ask spread. In other words, the greater the heterogeneity of information among investors, the wider the bid-ask spreads. Second, we use the numbers of earnings estimates made by sell-side financial analysts since it represents for the numbers of active financial analysts following a firm, and thus as a proxy for firms information environment. Finally, we estimate a firm's ex-ante implied cost of equity capital based on reverse-engineering residual income valuation model.

We state our question of interest and its respective hypotheses as of the following:

Question: *Do firms with higher numbers of financial analysts have lower expected cost of equity capital?*

Hypothesis 1: *The number of financial analysts' earnings estimates is negatively associated with bid-ask spread.*

Hypothesis 2: *Bid-ask spread is positively associated with expected cost of equity capital.*

3.2 Variable Measurements and Regression Models

3.2.1 The number of financial analysts' earnings estimates is negatively associated with bid-ask spread (H1)

3.2.1.1 Dependent variable

The bid-ask spread (*SPREAD*) is the average relative spread (i.e., absolute spread divided by the average of bid and ask) for December 2008.

3.2.1.2 Independent variable

The numbers of earnings estimates made by financial analysts (*ANF*) can be used as a substitute for the numbers of financial analysts following a firm. *ANF* for a financial year 2008 is thus the numbers of financial analysts' earnings estimates for that year, forecasted at the end of the year.

3.2.1.3 Control variables

Existing researches suggest that bid-ask spread is positively related to dispersion in analysts' earnings forecasts (*FDISP*); negatively related to firm size (*MV*), percentage of share

free float (*FLOAT*), and average share price (*P*) (e.g., see Leuz and Verrecchia (2000); Chiang and Venkatesh (1988)).

3.2.1.4 Regression model

Hypothesis 1 can be examined through a multiple linear regression model expressed by the following equation, hereafter referred to as equation one (E1).

$$\log(SPREAD_i) = \beta_0 + \beta_1 \log(ANF_i) + \beta_2 \log(FDISP_i) + \beta_3 \log(MV_i) + \beta_4 \log(FLOAT_i) + \beta_5 \log(P_i) + \varepsilon_i \quad (E1)$$

3.2.2 Bid-ask spread is positively associated with expected cost of equity capital (H2)

3.2.2.1 Independent variable

Defined above, *SPREAD* however serves instead as independent variable in hypothesis 2, while it serves as dependent variable in hypothesis 1.

3.2.2.2 Dependent variable

This paper employs accounting-based methods to estimate expected cost of equity capital, rather than theory-based methods (e.g., CAPM)⁽¹⁾. With regards to accounting-based method, prior researches attempting to compare the performance of each implied cost of equity model document that cost of equity capital implied from the residual income valuation model outperforms that from the abnormal earnings growth valuation model (e.g., Gode and Mohanram (2003); Ahn et al. (2008)). We implemented finite horizon version of residual income model, based on empirical implementation of Gebhardt, Lee, and Swaminathan (2001), and we limit our analysis to firms with December fiscal year-end since the majority of US firms have December fiscal year-end and so that the implied cost of equity capital are estimated under the same circumstance. Cost of equity capital for the year 2008 is estimated on its fiscal year-ending date. Its algebraic equation can be written as of the following:

$$P_0 = Fbps_0 + \sum_{t=1}^4 \frac{(Froe_t - r_{GLS}) \times Fbps_{t-1}}{(1 + r_{GLS})^t} + \sum_{t=5}^{99} \frac{(Froe_t - r_{GLS}) \times Fbps_{t-1}}{(1 + r_{GLS})^t} + \frac{(Froe_{10} - r_{GLS}) \times Fbps_{09}}{r_{GLS} \times (1 + r_{GLS})^{09}}$$

Where:

r_{GLS}	= Implied cost of equity capital based on GLS method
P_0	= Price of share at year $t = 0$
$Fb\psi_t$	= Forecasted book value of equity per share at year t
$Feps_t$	= Forecasted earnings per share at year t
$Froe_t$	= Forecasted return on equity capital at year t where $Froe_t = Feps_t / Fb\psi_{t-1}$
$(Froe_t - r_{GLS}) \times Fb\psi_{t-1}$	= Forecasted Residual income (RI)

Above equation is tenth-degree polynomial equation with respect to cost of equity capital r_{GLS} . In general, the n th-degree polynomial equation has exactly n solutions. Using *Mathematica* software, we identified ten unique solutions for r_{GLS} . The formulas are not reproduced here due to their extraordinary length; however, each defines r_{GLS} as a function of the same set of variables. In each case, one solution is positive value, another one is negative value, and the rest are in the form of complex numbers. Since cost of equity capital is positive value, a positive solution is chosen as an estimate of cost of equity capital. Inputs required for the computation are discussed below:

(a) Price and Book Value of Equity at $t=0$

While closing share price on December 31, 2008 is readily available, firm's book value of common equity is not; its value is therefore calculated by adding forecasted earnings (i.e., earning per share for the fiscal year ended on December 31, 2008) to reported book value of equity from previous one year $t=-1$ (i.e., book value as of December 31, 2007) and subtracting forecasted dividends paid. In order words, $Fb\psi_0 = b\psi_{-1} + Feps_0 - Fd\psi_0$, assuming clean surplus relation. Closing share price P_0 and reported book value of equity per share $b\psi_{-1}$ are obtained from *Thomson Datastream* (*Datastream* data type: P, WC05476). Forecasted earnings and dividend are discussed in later section.

(b) Forecast of Residual Income

The forecast of residual income requires forecasted earning per share ($Feps_t$), dividend payout ratio (k), forecasted book value of equity per share ($Fb\psi_t$), and forecasted return on equity ($Froe_t$), all of which are explained in the following:

(b.1) Forecast Horizon

(b.1.1) Explicit forecast period

Thomson I/B/E/S database provides consensus of all available individual financial analysts' earnings forecasts. So far, the underlying premise is that all analysts' forecasts refer to future financial year-end dates. However, there are cases in which those earnings forecasts for the one-year-ahead period refer to a current year. This situation arises as of the following reason. *I/B/E/S* provides monthly consensus forecasts as of the third Thursday of each month. To ensure that their forecasts are current, *I/B/E/S* updates by rolling forward by one year the fiscal year-end of all their forecasts in the month when the actual annual earnings are announced. For instance, a December year-end firm may announce its annual earnings in the second week of February of the following year. In response to the announcement, *I/B/E/S* forecasts for that month will be moved to the next financial year. This ensures that one-year-ahead forecast is always available for the next unannounced fiscal-year end. Therefore, since on December 31, 2008, firms have not yet announced their FY 2008 earnings, the one-year-ahead earnings estimate in *I/B/E/S* refers to that (current) 2008 financial year-end date. That is, the one-year-ahead earnings forecasts in *I/B/E/S* as of December 31, 2008 refer to earnings forecasts of fiscal year ending on December 31, 2008 to be reported ($Feps_0$), not on December 31, 2009 ($Feps_1$). Consequently, $Feps_1$, $Feps_2$, $Feps_3$, $Feps_4$ corresponds to *I/B/E/S* two-year-ahead, three-year ahead, four-year ahead, and five-year ahead earnings forecasts.

In short, as of December 31, 2008, earnings forecasts include forecasts for a fiscal year ending to be reported (i.e., $Feps_0$) and either forecasts for each of the fiscal year ending on December 31, 2009, 2010, 2011, and 2012 (i.e., $Feps_1$, $Feps_2$, $Feps_3$, and $Feps_4$) or the forecast for the fiscal year ending on December 31, 2009 and a forecast of growth in earnings for the subsequent three years (i.e., $Feps_1$ and g_{IBES}). In effect, we have explicit forecasts for the subsequent four years. When available, we use the actual forecasts for each subsequent year, and when these forecasts are not available, we use the forecast for 2009 and calculate forecasts for 2010 through 2012 using analysts' forecasts of growth in earnings. These values are generated by projecting that growth rate in earnings on the prior year's earnings forecasts. In other words,

$$Feps_2 = Feps_1 + abs(Feps_1) \times g_{IBES}$$

$$Feps_3 = Feps_2 + abs(Feps_2) \times g_{IBES}$$

$$Feps_4 = Feps_3 + abs(Feps_3) \times g_{IBES}$$

where $abs(.)$ refers to absolute value

Correspondently, we choose to collect median value of all earnings forecasts for $Feps_0$, $Feps_1$, $Feps_2$, $Feps_3$ and $Feps_4$ (I/B/E/S Data type: F1MD, F2MD, F3MD, F4MD, and F5MD), as well as median value of long-term anticipated annual growth rate in earnings over a five year period g_{IEES} (I/B/E/S Data type: LTMD) as of December 31, 2008. These earnings forecasts together with dividend payout ratio (k) are used to correspondently generate each forecasted book values of equity and return on equity ($Fbps_t$ and $Froe_t$, where $t=1$ to 4), all of which are elaborated in subsequent section.

(b.1.2) Implicit Forecast Period

$Froe_t$ after four-year ahead cannot be explicitly computed since its component, earnings forecasts, from that period are not provided by financial analysts. $Froe_t$ as a result are implicitly estimated, based on its *mean-reverting behavior*. In order words, the behavior of return on equity capital is characterized as a mean-reverting process: firms with above-average and below-average rate of return on equity capital tend to revert over time to a normal (average) level within no more than ten years (Palepu and Healy 2007; Penman 1992). Consistent with Gebhardt, Lee, and Swaminathan (2001), we assume that ROE is mean-reverting over time. In particular, we assume that forecasted ROEs mean revert toward the median ROE of the industry over the period of 10 years. We therefore forecast five-year head ROEs onwards ($Froe_t$, $t=5$ to 9) implicitly by mean-reverting each firms' four-year ahead ROEs ($Froe_4$) to the industry median ROE by period ten ($t=10$). This mean-reversion can be achieved via simple linear interpolation between four-year ahead ROE and ten-year ahead industry median ROE. That is, if forecasted ROE in four-year ahead is higher (lower) than industry median ROE in ten-year ahead, forecasted ROEs after four-year ahead falls (rises) at a constant rate each year, reverting to the industry median ROE.

To compute forecasted industry ROE, we group all stocks into the forty-industry classification based on Industrial classification benchmark (ICB). Since the industry target ROE is not observable, historical industry median ROE is used as a proxy. Ten years of past ROEs (i.e., from period $t = -10$ to period $t = -1$) are employed to compute this median. Since loss is temporary for a going concern and consistent with Gebhardt, Lee, and Swaminathan (2001), we exclude loss-making firms on the basis that the population of profit-making firms better reflects long-term industry equilibrium ROE in computing median industry ROE. Return on equity capital is obtained from *Thomson Datastream* (Datastream datatype: WC08301).

(b.2) Terminal Value

We further assume that from ten-year ahead ($t=10$) to infinity, residual income will be the same as that of year ten and will remain infinitely constant. This does not imply that earnings do not grow after ten-year ahead. Rather it assumes that any growth in earnings after that is value neutral.

(b.3) *Dividend payout ratio (k)*

An estimate of the dividend payout ratio is required for the computation of future book value of equity. We assume that firms maintain its dividend payout policies; that is, it will be sustained in the future. A firm-specific dividend payout ratio (k) is defined as an average of its dividend payout ratio in the last ten years. Dividend payout ratio is obtained from *Thomson Datastream* (Datastream datatype: WC09504).

(b.4) *Future book value of common equity*

Based on the concept of clean surplus accounting, forecasted book value of equity can be estimated by adding forecasted earnings to previous-year forecasted book value of equity, and subtracting forecasted dividend paid. In order words, $Fbps_t = Fbps_{t-1} + Feps_t - Fdps_t$. By assuming that current dividend payout ratio (k) will be sustained in the future, forecasted book value of equity can derived from the following equation.

$$\begin{aligned} Fbps_0 &= bps_1 + (1-k) \times Feps_0 \\ Fbps_1 &= Fbps_0 + (1-k) \times Feps_1 \quad \text{or} \quad Fbps_1 = [1 + (1-k) \times Froe_1] \times Fbps_0 \\ Fbps_2 &= Fbps_1 + (1-k) \times Feps_2 \quad \text{or} \quad Fbps_2 = [1 + (1-k) \times Froe_2] \times Fbps_1 \\ &\vdots \\ Fbps_t &= Fbps_{t-1} + (1-k) \times Feps_t \quad \text{or} \quad Fbps_t = [1 + (1-k) \times Froe_t] \times Fbps_{t-1} \end{aligned}$$

3.2.2.3 Control variables

Existing researches suggest that cost of equity capital is negatively related to firm size (MV), and positively related to book-to-price ratio (B/P), market beta ($BETA$), financial leverage (LEV), and earnings variability ($EVAR$) (Fama and French (1995); Berk (1995); Modigliani and Miller (1958)). It also suggests that cost of equity capital varies between industries (e.g., Gebhardt, Lee, and Swaminathan (2001), Ahn et al. (2008)).

3.2.2.4 Regression model

Hypothesis 2 can be examined through a multiple linear regression model expressed by the following equation, hereafter referred to as equation two (E2).

$$r_{GLSi} = \beta_0 + \beta_1 \log(SPREAD_i) + \beta_2 \log(MV_i) + \beta_3 B/P_i + \beta_4 BETA_i + \beta_5 \log(LEV_i) + \beta_6 \log(EVAR_i) + \sum_{j=1}^9 \delta_j INDUST_j + \varepsilon_i \quad (E2)$$

3.3 Sample Selection

Our sample of firms consists of all U.S. companies with December fiscal-year end, covered by *I/B/E/S* database as of December 31, 2008 and is further limited by the availability of data to compute relevant dependent, independent and control variables. In short, we include observations that fulfill the following requirements:

- (1) *I/B/E/S* covered firms with fiscal year ending on December 31.
- (2) Data availability and restriction to compute relevant dependent and independent variables.
- (3) Data availability to compute relevant control variables.

Fulfilling the above requirements, the final sample is 2,106 firm-observations for hypothesis 1, and 1,700 firm-observations for hypothesis 2.

4. Empirical Results

4.1 Empirical analyses on hypothesis one (H1)

4.1.1 Descriptive Statistics and Regression Result

Table 4.1 and 4.2 present both descriptive statistics of equation one (E1)'s variables and its Pearson correlation coefficients. In our sample, the number of financial analysts following a firm (*ANF*) range from two analysts to thirty seven analysts with median of six analysts. This suggests there are substantial variation in the value of independent variable, which satisfies one of the assumption of classical linear regression model, which requires that independent variable must vary to some extent (Gujarati 2003). Table 4.2 exhibits list-wise Pearson correlation coefficients among regression variables. Overall, bid-ask spread (*SPREAD*) is correlated with independent and control variables with the expected sign, and its correlation coefficients are significantly different from zero. Expectedly, it exhibits a negative correlation with the numbers of financial analysts (*ANF*), suggesting that firms with many financial analysts coverage have small bid-ask spread. In addition, it posits a negative correlation with firm size (*MV*), percentages of share free float (*FLOAT*), average share price (*P*), and positive correlation with dispersion in analyst earnings forecast (*FDISP*).

Table 4.3 presents regression results of equation one (E1) where outliers are excluded using *Cook's distance* statistic, and standard errors are computed using White's (1980) method. Empirical studies employing regression analysis of cross-sectional data often face the problem of heteroscedasticity of the error terms. By far, the most important consequence is that interval estimation and hypothesis testing can no longer be trusted, which calls into question the reliability of statistical inference (Gujarati, 2003, p. 427). In other words, heteroscedasticity does not bias the coefficient estimates but it does bias the standard errors of those coefficients. Testing the regression's residuals for heteroscedasticity using the *Breusch-Pagan* and *Cook-Weisberg* methods suggests that heteroscedasticity is likely to be a problem in the case at hand. To account for it, we use t-statistics based on White's (1980) heteroscedasticity-consistent standard errors (Robust Standard Error) in the significant tests.

Table 4.1 Descriptive statistics for regression variables of equation one (E1)

	Mean	Std. Dev.	Min	25%	Median	75%	Max
SPREAD	0.013	0.037	0.001	0.002	0.004	0.010	1.164
ANF	7.258	5.266	2.000	3.000	6.000	10.000	37.000
FDISP	21.075	288.191	0.000	1.563	3.535	9.091	12400.000
MV	3394.643	14639.358	2.620	161.140	502.030	1773.240	406067.000
FLOAT	78.314	17.737	12.000	70.000	82.000	92.000	100.000
P	63.103	2143.910	0.063	4.332	11.363	22.570	98398.258
Observations	2106						

Table 4.2 Pearson correlation coefficients for regression variable of equation one (E1)

	$\log(\text{SPREAD})$	$\log(\text{ANF})$	$\log(\text{FDISP})$	$\log(\text{MV})$	$\log(\text{FLOAT})$	$\log(\text{P})$
$\log(\text{SPREAD})$	1					
$\log(\text{ANF})$	-0.551***	1				
$\log(\text{FDISP})$	0.115***	0.0430*	1			
$\log(\text{MV})$	-0.770***	0.640***	-0.0726***	1		
$\log(\text{FLOAT})$	-0.164***	0.0831***	-0.0448*	0.179***	1	
$\log(\text{P})$	-0.749***	0.434***	-0.139***	0.776***	0.138***	1
Observations	2106					

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.3 Cross-sectional regression of equation one (E1)

$$\log(\text{SPREAD}_i) = \beta_0 + \beta_1 \log(\text{ANF}_i) + \beta_2 \log(\text{FDISP}_i) + \beta_3 \log(\text{MV}_i) + \beta_4 \log(\text{FLOAT}_i) + \beta_5 \log(P_i) + \varepsilon_i \quad (\text{E1})$$

Variables	Expected Sign	Coefficient	Robust Std. Error	t-Statistics	p-value
$\log(\text{ANF})$	-	-0.230***	0.023	-10.10	0.000
$\log(\text{FDISP})$	+	0.024***	0.005	4.92	0.000
$\log(\text{MV})$	-	-0.184***	0.014	-13.53	0.000
$\log(\text{FLOAT})$	-	-0.050	0.045	-1.12	0.262
$\log(P)$	-	-0.427***	0.017	-24.64	0.000
Constant		-2.608***	0.189	-13.77	0.000
Observations		1974			
R^2		0.723			
Adjusted R^2		0.722			
F		1016.9			

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$\log()$ is a natural logarithm of variable; *SPREAD* is the average of daily spreads, the difference between bid and ask prices, divided by the average of bid and ask for December 2008; *ANF* is the numbers of earnings forecasts made by financial analysts for that financial year ending on December 31, 2008; *FDISP* is the ratio of the standard deviation of all the forecasts to absolute value of mean value of all those forecasts; *MV* is market value of common equities of firms at the end of the year 2008; *FLOAT* is the average of daily percentage of the total numbers of shares outstanding of a firm that is available for trading by the investing publics and is not held for strategic goals for December 2008; and *P* is the average of daily share price of a firm for December 2008

4.1.2 Regression Assumptions

To check robustness of our result, we examine the assumptions of OLS regression. We first examine normality of regression's residual. Normality of residuals is only required for valid hypothesis testing in that it assures p -values for the t -tests and F -test will be valid. It is not required to obtain unbiased estimates of regression coefficients. In other words, normality assumption of residuals enables us to derive the probability, or sampling distributions of regression coefficients to be normally distributed, which simplifies the task of establishing confidence intervals and testing statistical hypotheses (Gujarati, 2003, p. 112). Normality is however a concern only when the size of the sample is small. Since, our sample size is relatively large, the distribution of regression coefficients are shown to be asymptotically normal. In other words, normality of regression error terms is of less concern when the sample size is large. However, as a robustness check, we further employ *bootstrapping* method, which can estimate regression coefficients' standard errors and thus confidence intervals when the residuals may not be distributed normally or even approximately normally

(Kennedy 2008). Bootstrap method begins by first estimating the regression model (*E1*) and saving the residuals. It then performs a *Monte Carlo* procedure, using the estimated parameter values (regression coefficients) as the "true" parameter values and the actual values of the independent variables as the fixed independent variable values. During this Monte Carlo study, residuals are first drawn *with replacement* from the set of original residuals; a new set of dependent variable values are then computed; and new regression coefficients are estimated. Replicating this procedure for 5,000 times enables us to estimate sampling distributions of regression coefficients and thus estimate their standard errors, known as bootstrapped standard errors. The result (not shown) shows that most of t-statistics of our variables are smaller when standard errors are computed using bootstrapping method, suggesting regression coefficients are less likely to be significant. In particular, although t-statistics of our variables of interests are smaller when standard errors are estimated using bootstrapping method, it still remains statistically and significantly different from zero. Next, multicollinearity among explanatory variables makes the estimation of regression coefficients difficult and its standard errors large. Myers (1990) suggests that a *variance inflation factor* (*VIF*) value of 10 or more causes a concern of multicollinearity. In our sample, we check the value of *VIF* of each regression variables, and no *VIF* value is greater than 3.69, suggesting multicollinearity is unlikely to be a problem.

4.1.3 Supplementary Analyses

We additionally run various regression specifications by including other variables that might be related to bid-ask spread in order to check if the conclusion remains qualitatively the same.

First, with a concern that bid-ask spread may be different among the stock exchanges where firms are listed, we include three dummy variables for four categories: New York Stock Exchange, NASDAQ, AMEX, and others. The result suggests that our conclusion remains qualitatively the same. Next, in addition to earnings forecast dispersions, forecasts errors (*FEROR*) might also be used as a proxy for information precision. That is, if analysts provide expected earnings forecast with low accuracy, precision of investors expectation about the firm's future earnings is also low (Francis, Olsson, and Schipper 2006; Mansi, Maxwell, and Miller 2007). Forecast error (*FERROR*), defined as the difference between consensus analyst earnings forecasts and actual forecasts scaled by actual forecasts, is included as additional control variable. The result reveals that *FERROR* is not statistically and significantly different from zero, and $\log(ANF)$ still remains statistically and significantly different from zero. Finally,

rather than using transformation form of ANF (i.e., $\log(ANF)$), we instead use its original form (i.e., ANF) and conclusion of our result is insensitive to this alternative form. In sum, our conclusion remains qualitatively the same regardless of various regression specifications.

4.2 Empirical analyses on hypothesis two (H2)

4.2.1 Summary Statistics and Regression Result

Descriptive statistics for regression variables as well as its Pearson correlation coefficients of equation two (E2) are presented in Table 4.4 and 4.5. Firms' expected cost of equity capital (r_{GLS}), estimated on December 31, 2008, range from approximately 4.7% at 1 percentile to 34.2% at 99 percentile with its 12.7% (11.5%) mean (median). Importantly, Table 4.5 suggests that expected cost of equity capital (r_{GLS}) increases in bid-ask spread ($SPREAD$). It correspondently accords with theoretical models arguing that high level of adverse selections translates into high expected cost of equity capital for a firm. Moreover, as expected, r_{GLS} is decreasing in firm size, and increasing in book-to-price ratio, market beta, financial leverage, and earnings variability. All of correlation coefficients are significantly different from zero. Table 4.6 presents regression result of equation two (E2) where outliers are excluded using *Cook's Distance* statistics, standard errors are computed using White's (1980) method, and outputs of regression coefficients of 9 *INDUST* variables are suppressed. First, the overall model is highly significant with R-square (adjusted R-square) of 63% (62.7%). This adjusted R-square is similar to prior empirical studies investigating the determinants of cross-sectional difference in implied cost of equity capital estimates (e.g., Gebhardt, Lee, and Swaminathan (2001); Ahn et al. (2008)).

Second, a valid estimate of cost of equity capital should be related with well-known risk factors such as market beta and additional risk factors including firm size and book-to-price ratio as suggested by Fama and French (1995). In our result, r_{GLS} is expectedly increasing in both $BETA$ and B/P , and decreasing in $\log(MV)$ with its significantly non-zero correlation coefficients, suggesting that our estimated cost of equity capital be valid.

Last but not least, taking common well-known risk factors of r_{GLS} into account, regression coefficients of $\log(SPREAD)$ is expectedly positive, and significantly different from zero. All regression coefficients of other variables have the expected signs and are significantly different from zero. In sum, the result suggests that, after controlling for common risk factors affecting expected cost of equity capital, firms with high level of bid-ask spreads have high expected cost of equity capital.

4.2.2 Regression Assumptions

As in the case of equation one (E1), we further use bootstrapping method in order to estimate regression coefficients' standard errors and confidence intervals, assuming that the normality of residuals' assumption does not hold. The result suggests that, despite changes in t -statistics; the significances of regression coefficients remain unchanged. In particular, r_{GLS} is increasing with $\log(SPREAD)$. Next, we inspect *individual inflation factor (VIF)* of each regression variables. In our sample, no *VIF* value of any explanatory variables is greater than 2.59, suggesting that multicollinearity is unlikely to be a concern.

4.2.3 Supplementary Analyses

4.2.3.1 Sensitivity Analysis

We earlier estimate expected cost of equity capital using forecast horizon of 10 years by assuming ROE mean-reverts within ten years. To check if the conclusion of the result is sensitive to this assumption, we additionally estimate expected cost of equity capital using forecast horizon of 12, 15, and 20 years and re-run our regression. The result (not presented) shows that the means of implied cost of equity capital estimates among various scenarios have very little differences (e.g., 12.9% with 10-year ROE mean-revert assumption and 12.8% with 12-year ROE mean-revert assumption), and in particular, our conclusion remains the same regardless of the alternative cost of equity capital estimates.

Table 4.4 Descriptive statistics for regression variables of equation two (E2)

	Mean	Std. Error	1%	25%	Median	75%	99%
r_{GLS}	0.128	0.057	0.047	0.092	0.115	0.146	0.342
<i>SPREAD</i>	0.011	0.025	0.001	0.002	0.003	0.007	0.118
<i>MV</i>	3982.220	15907.366	13.805	209.010	561.830	2202.130	69980.469
<i>B/P</i>	1.081	1.816	-0.166	0.451	0.742	1.190	8.056
<i>BETA</i>	1.147	0.439	0.266	0.832	1.113	1.438	2.243
<i>LEV</i>	0.002	0.009	0.000	0.000	0.000	0.001	0.026
<i>EVAR</i>	4.366	79.403	0.039	0.288	0.515	1.021	16.321
Observations	1700						

Table 4.5 Pearson correlation coefficients for regression variables of equation two (E2)

	Mean	log(SPREAD)	log(MV)	B/P	BETA	log(LEV)	log(EVAR)
r_{GLS}	1						
log(SPREAD)	0.463***	1					
log(MV)	-0.359***	-0.740***	1				
B/P	0.453***	0.328***	-0.266***	1			
BETA	0.262***	0.0388	-0.0236	0.103***	1		
log(LEV)	0.364***	0.212***	-0.0135	0.240***	0.172***	1	
log(EVAR)	0.174***	-0.110***	0.142***	0.0122	0.184***	0.144***	1
Observations	1700						

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4.6 Cross-sectional regression of equation two (E2)

$$r_{GLSi} = \beta_0 + \beta_1 \log(SPREAD_i) + \beta_2 \log(MV_i) + \beta_3 B/P_i + \beta_4 BETA_i + \beta_5 \log(LEV_i) + \beta_6 \log(EVAR_i) + \sum_{j=1}^9 \delta_j INDUST_j + \varepsilon_i \quad (E2)$$

Variables	Expected Sign	Coefficients	Robust Std. Error	t-Statistics	p-value
log(SPREAD)	+	0.007***	0.001	4.99	0.000
log(MV)	-	-0.003***	0.001	-4.38	0.000
B/P	+	0.015***	0.002	7.94	0.000
BETA	+	0.017***	0.002	9.07	0.000
log(LEV)	+	0.005***	0.001	7.42	0.000
log(EVAR)	+	0.005***	0.001	6.40	0.000
Constant		0.186***	0.015	12.65	0.000
<i>INDUST (Included)</i>					
Observations	1620				
R^2	0.630				
Adjusted R^2	0.627				
F	139.7				

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

log (.) is a natural logarithm of variable; r_{GLS} is cost of equity capital estimates under GLS (2001) method; SPREAD is the average of daily spreads, the difference between bid and ask prices divided by the average of bid and ask for December 2008; MV is market value of common equities of firms at the end of the year 2008; B/P is book value of common equity to price ratio at the end of the year 2008; $BETA$ is market beta at the end of the year 2008; LEV is financial leverage defined as the ratio of debts to firm's market value of common equity at the end of the year 2008; $EVAR$ is standard deviation of annual earnings for the past five years; and $INDUST$ is 9 indicator variable(s) based on industry classification benchmark (ICB) code.

Table 4.7 Comparative Regression Results using Various Cost of Equity Capital Methods

	GLS	CT	MOJ	OJ	MPEG	PE	AVG
<i>log</i> (SPREAD)	0.00672*** (4.99)	0.00897*** (4.87)	0.00880*** (5.15)	0.0162*** (6.44)	0.0167*** (6.55)	0.00999*** (4.84)	0.00781*** (4.82)
<i>log</i> (MV)	-0.00294*** (-4.38)	-0.00124 (-1.38)	-0.000814 (-0.93)	-0.00193 (-1.57)	-0.00351** (-2.90)	-0.00203 (-1.78)	-0.00243** (-3.14)
<i>B/P</i>	0.0152*** (7.94)	0.0104*** (6.89)	0.00807*** (5.38)	0.0102*** (4.38)	0.00980*** (4.45)	0.0126*** (6.86)	0.0146*** (7.86)
<i>BETA</i>	0.0167*** (9.07)	0.0196*** (6.88)	0.0180*** (6.87)	0.0318*** (8.10)	0.0327*** (8.24)	0.0146*** (4.22)	0.0244*** (9.40)
<i>log</i> (LEV)	0.00480*** (7.42)	0.00566*** (8.01)	0.00248*** (3.75)	0.00602*** (6.42)	0.00531*** (5.63)	0.00865*** (10.43)	0.00516*** (8.40)
<i>log</i> (EVAR)	0.00465*** (6.40)	0.00271** (2.66)	0.00193* (2.37)	0.00233 (1.93)	0.00322* (2.53)	0.00761*** (6.99)	0.00364*** (3.56)
<i>Constant</i>	0.186*** (12.65)	0.187*** (14.72)	0.172*** (14.99)	0.247*** (14.47)	0.247*** (14.48)	0.220*** (16.54)	0.183*** (16.01)
<i>INDUSTs</i>							
Observations	1620	1536	1393	1438	1442	1832	1198
R^2	0.630	0.341	0.237	0.340	0.359	0.303	0.516
Adjusted R^2	0.627	0.335	0.228	0.333	0.352	0.298	0.510

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2.3.2 Alternative accounting-based cost of equity capital estimates

Despite prior empirical evidences suggesting that implied cost of equity capital from the residual income valuation model outperforms that from the abnormal earnings growth valuation model (e.g., Gode and Mohanram (2003); Ahn et al. (2008)), there is still no consensus in favor of particular model. Therefore, if our results are valid, a statistically significant link between bid-ask spread and implied cost of equity capital should be documented not only with GLS (2001) method but also other various methods, assuming that these methods produce valid cost of equity capital estimates.

We thus repeat our tests on different cost of equity capital estimates from various well-known methods documented in literature, all of which are derived from either residual income or abnormal earnings growth model. We label r_{CT} as the estimate of implied cost of equity capital from Claus and Thomas (2001) method; r_{OJ} as that from Gode and Mohanram (2003) and Ohlson and Juettner-Nauroth (2005) method; r_{MOJ} as that from our additional specification from Ohlson and Juettner-Nauroth (2005) method; r_{PE} as that from price-earnings ratio

method; r_{MPEG} as that from Easton (2004) method; and finally r_{AVG} as that from average of these methods⁽²⁾.

The estimates of cost of equity capital from these methods range from a mean of 11.8% for r_{CT} to a mean of 15.7% for r_{CJ} . Table 4.7 presents the result of regressing costs of equity capitals estimated from various methods on our variable of interest *SPREAD*, where outliers are excluded using *Cook's Distance* statistics, and standard errors are computed using White's (1980) method. The overall models of each regression are highly significant. As expected, the adjusted *R*-square of a model when cost of equity capital is implied using GLS (2001) is highest, and this is consistent with prior studies documenting that GLS (2001) method is superior to others. The coefficients of $\log(\text{SPREAD})$ are shown to be positively related to each cost of equity capital estimates and are significantly different from zero. All other variables, when statistically and significantly different from zero, have the expected signs. In sum, the results suggest that a positive relationship between bid-ask spread and cost of equity capital persist, regardless of the methods used, and thus additionally confirm our above-documented results.

5. Conclusion

This research studies whether firms with higher number of financial analysts' coverage have lower expected cost of equity capital, motivated from existing theoretical models which argue that information reduces a firm's cost of equity capital by reducing adverse selection component of information asymmetry. Our result suggests that firms with higher numbers of financial analysts' coverage have smaller bid-ask spreads which in turns have lower expected cost of equity capitals. Our empirical results support adverse-selection/market liquidity theoretical models.

[Notes]

- (1) Issues of using theory-based models when examining a link between information and cost of capital.

The reason this paper uses accounting-based estimates when examining the relationship between information and cost of equity capital is that theory-based estimates (e.g., CAPM) are not useful in this purpose. These points are raised, for example, by Botosan (2006), which states that,

"Whether estimated using the CAPM or some other multifactor model, the resulting cost of equity

capital estimates are not useful to empiricists investigating the link between disclosure and cost of equity capital. Because these models assume that the priced risk factors are known and limited to the factors in the model, the nature of the empirical relation between disclosure and cost of equity capital is preordained. If the model does not include disclosure related risk as a priced risk factor, the relevant question becomes whether disclosure is related to any of the factors that are in the model. For example, since the CAPM limits the risk factors to market beta, disclosure can impact cost of equity capital only if it impacts market beta. But, the hypothesis that more disclosure reduces market beta enjoys little theoretical support."

Table 4.5 in the paper shows that the correlation between Beta, which is the only priced risk factor in CAPM, and bid-ask spread is not statistically significant. This correlation suggests that Beta may not capture information-related risks, and thus not useful in this purpose of study.

(2) Alternative cost of equity capital method

(a) *Claus and Thomas (2001) method*

A method implemented by Claus and Thomas (2001) is different from that by Gebhardt, Lee, and Swaminathan (2001) in terms of perpetual growth assumption in estimating terminal value. Specifically, expected cost of equity capital can be implied from the following equation:

$$P_0 = Fb\psi_0 + \sum_{t=1}^4 \frac{(Feps_t - r_{CT} \times Fb\psi_{t-1})}{(1 + r_{CT})^t} + \frac{(Feps_4 - r_{CT} \times Fb\psi_3) \times (1 + g)}{(r - g) \times (1 + r_{CT})^4}$$

Where:

r_{CT} is the cost of equity capital under CT method. All other input except g are previously defined. g is the growth rate of residual income in perpetuity, assumed to be equal to the expected inflation rate. In particular, CT assume that growth in residual income will be at the rate of inflation, estimated as the nominal risk-free rate minus the real risk-free rate (estimated to be 3%). Empirically, growth in residual income beyond forecast horizon is 10-years government T-bond yield minus 3%. (i.e., $r_f - 3\%$). We also use the ten-year government T-bond rate at the date of estimation to proxy for the risk-free rate. However, it is unrealistic to use 3% as an estimate of real-risk free rate since real-risk free rate varies over time. In 1997, the U.S. Treasury began issuing indexed bonds, which payments linked to inflation, also known as Treasury Inflation Protected Security (TIPS) since payments including the principal are tied to inflation. To date, the Treasury has issued these *indexed bonds*, ranging from 5 to 20 years. The yield on this shortest-term bond therefore provides a good estimate for the real risk-free rate, since it has essentially no risk (Ehrhardt and Brigham 2009).

(b) *Ohlson and Juettner-Nauroth (2005) method*

Ohlson and Juettner-Nauroth (2005) method equates the value of a firm with capitalized next-period earnings per share and the future abnormal growth in earnings per share. Its finite horizon version is as of the following:

$$r_{OJ} = A + \sqrt{A^2 + \frac{Feps_1}{P_0} \left(\frac{Feps_2 - Feps_1}{Feps_1} - g \right)}$$

Where:

$$A \equiv \frac{1}{2} \left(g + \frac{Fdps_1}{P_0} \right)$$

r_{OJ} is cost of equity capital under OJ method and all other variables are defined previously.

(c) *Price-Earnings Ratios (Special case of Ohlson and Jeuttner-Nauroth (2005) model)*

Cost of equity capital is estimated as the inverse of the forward PE ratio. That is,

$$r_{PE} = \frac{1}{PE_{ratio}}$$

Where:

$$PE_{ratio} = \frac{P_0}{eps_1}$$

r_{PE} is cost of equity capital under Price-Earnings ratio and all other variables are defined previously.

(d) *Modified Price-Earnings Growth method*

Easton (2004) derives a restricted version of Ohlson and Jeuttner-Nauroth (2005) model. Under the assumption of zero dividends and zero growth in abnormal earnings, expected cost of equity capital can be obtained from the following expression:

$$r_{MPEG} = \sqrt{\frac{Feps_2 - Feps_1}{P_0}}$$

Where:

r_{MPEG} is cost of equity capital under modified Price-Earnings Growth method and all other variables are defined previously.

(e) *Our modified Ohlson and Jeuttner-Nauroth (2005) method*

We derive additional specification from the Ohlson and Jeuttner-Nauroth (2005) method. Their method assumes that z_2 grows perpetuity with a constant rate g where it can be algebraically simplified into a second order polynomial equation. However, their method does not employ all information in financial analysts' earnings forecasts including long-term growth forecasts. Instead, we explicitly forecast abnormal earnings growth from z_2 to z_4 , and assume that z_4 grows perpetuity at a constant rate g . Its equation is expressed as of the following:

$$P_0 = \frac{eps_1}{r_{MOJ}} + \frac{z_2}{r_{MOJ}(1+r_{MOJ})^1} + \frac{z_3}{r_{MOJ}(1+r_{MOJ})^2} + \frac{z_4}{r_{MOJ}(1+r_{MOJ})^3} + \frac{z_4(1+g)}{r_{MOJ}(1+r_{MOJ})^4} + \frac{z_4(1+g)^2}{r_{MOJ}(1+r_{MOJ})^5} + \dots$$

Above equation is algebraically equal to:

$$P_0 = \frac{eps_1}{r_{MOJ}} + \frac{z_2}{r_{MOJ}(1+r_{MOJ})^1} + \frac{z_3}{r_{MOJ}(1+r_{MOJ})^2} + \frac{z_4}{r_{MOJ}(1+r_{MOJ})^3} + \frac{z_4(1+g)}{r_{MOJ}(r_{MOJ}-g)(1+r_{MOJ})^3}$$

Where: $z_i = eps_i - eps_{i-1} - r_{MOJ}(eps_{i-1} - dps_{i-1})$ and r_{MOJ} is cost of equity capital under modified OJ method. All other variables are defined previously.

(f) *Combined cost of equity capital estimates*

Given the strengths and weaknesses of individual methods to estimate a firm specific cost of equity capital, it seems reasonable to assume that the combinations of the existing methods could possibly

provide better results. We thus average all six methods, referred to as r_{AVG} .

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